

Reply

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In his Comment, *Campbell* [this issue] claims that we omitted key references supporting the statement that *Dst* is not a perfect measure of the symmetric ring current (RC). However, researchers have known for decades that *Dst* is not a perfect indicator of the ring current strength. It is evident even from its mathematical definition that *Dst* includes the contributions from the asymmetric ring and other currents. In fact, the essence of Figure 15 as discussed in subsection 7.2 of *Kamide et al.* [1998] appeared in the literature well before the presentations listed in the Comment by Campbell. For example, *Kamide and Fukushima* [1971] calculated storm time *Dst* variations from the asymmetric ring current system including field-aligned currents. One could also refer to the review of geomagnetic indices by *Rostoker* [1972, p. 947] in which it is stated

A major problem concerning the present *Dst* index is its inability to describe quantitatively the strength of the equatorial ring current. This inability stems from the paucity of stations (as few as three) from which the index is computed coupled with the tendency of the ring current to be asymmetric in all but the recovery phase of magnetic storms.

Baumjohann [1986, p. 10] cautioned

... the *Dst* uncertainties are mainly caused by magnetic contributions of sources other than the ring current to the *H* component at the four *Dst* observatories, namely (i) magnetopause current; (ii) asymmetric ring current; and (iii) substorm current wedge.

More recently, many of the coauthors of *Kamide et al.* [1998] published a review of magnetic storms stemming from a workshop held in Instituto de Pesquisas Espaciais, São José dos Campos, São Paulo, Brazil, in 1991. In this review by *Gonzalez et al.* [1994], it is clearly stated

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When we refer to an intensification of the “ring current,” we still do not know, physically, which currents are being monitored by the *Dst* index. Do tail currents and field-aligned currents have an appreciable effect? We also do not know the relative contribution of symmetric and asymmetric currents to the total ring current being monitored by the *Dst* index.

Thus, although Campbell’s cited references are in line with the discussion of the problems that make *Dst* an imperfect indicator of symmetric ring current which appears in our review [*Kamide et al.*, 1998], they are not unique in their content. We consider our selected citations accurately represent the history of the subject.

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